Abstract No. tzam259

Infrared Reflectivity Measurements on Polyaniline Films

G. Tzamalis[1], N. A. Zaidi[1], C. C. Homes[2] and A. P. Monkman[1]
[1]Department of Physics, University of Durham, South Road, Durham DH1 3LE, UK
[2]Department of Physics, Brookhaven National Laboratory, Upton, New York
Beamline(s): U10A

Introduction: Conducting polymers, being the latest generation of polymers, have attracted considerable research interest in the recent years and their importance has been widely acknowledged in the scientific community, culminating in the 2000 Nobel Prize award in Chemistry to three eminent researchers in the field [1]. Polyaniline (PANi) is an eminent member of the family of conducting polymers since it is environmentally stable with low cost and easy processibility and, most importantly, it shows fingerprints of metallic behavior like a non-zero value of DC conductivity at $T \rightarrow 0$ K and very high reflectivity in the far infrared [2-4]. Reflectance studies on different PANI samples were performed on a range from 20-9000 cm^{-1} .

Methods and Materials: Polyaniline in its base form (Emeraldine base) is an insulator. It becomes an conductor, albeit disordered, when it is protonated (doped) by an appropriate acid. Free standing films of PANi with slightly different individual characteristic such as doping level, were used for the reflectivity measurements. The measurements were taken using a Bruker IFS66v/S Fourier transform interferometer and by applying a combination of beamsplitters, light sources and detectors for each sub-range in order to get the most reliable results. The overlap between different regions was excellent.

Results: From the initial reflectivity results, the optical constants of a material can be obtained through the application of the KK transformation. Hence, the knowledge of fundamental quantities like the complex dielectric constant $\varepsilon=\varepsilon_1+i\varepsilon_2$, can be combined with a suitable theoretical model in order to understand the processes that take place in a disordered metal such a PANi. Each of the samples used was characterised by different extent of disorder and this was exhibited in the initial reflectivity results and in the subsequent derivations.

Conclusions: PANi samples show, at a varying degree, considerable high reflectivity at low wavenumbers (<400 cm^{-1}), reaching 90% for the most reflective samples. Such behavior is characteristic of a disordered metal and can be described by conventional localization physics in the context of the Anderson transition [5], as the localization modified Drude model was found to fit the deduced data. The effect of the doping level on the exhibited behavior has also been invenstigated.

References:

[1] A. J. Heeger, *J. Phys. Chem. B,* **2001,** *105*, 8475.
[2] G. Tzamalis, N. A. Zaidi, C. C. Homes, A. P. Monkman, *J. Phys.-Condes. Matter,* **2001,** *13*, 6297.
[3] P. N. Adams, P. Devasagayam, S. J. Pomfret, L. Abell, A. P. Monkman, *J. Phys.-Condes. Matter,* **1998,** *10*, 8293.
[4] E. R. Holland, S. J. Pomfret, P. N. Adams, A. P. Monkman, *J. Phys.-Condes. Matter,* **1996,** *8*, 2991.
[5] N. F. Mott 1990 *Metal-Insulator Transitions* (London: Taylor & Francis)